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ABSTRACT

This report offers the conclusions of a 1983 EPCOT symposium on education and the Information Age involving distinguished national experts and 46 secondary school principals from across the country. Discussed in the first section on "The Demands of an Information Age" are a number of transitions, including current shifts from an industrial to an information work force, from a national to a global economy, and from a centralized to a decentralized society. Section 2, "The Future World of Work," includes a list of new technology-related occupations for the 1990's and reviews prospects for non-technology jobs, preparation for the 21st century, and business-education partnerships. In the following section, "High Tech is Here to Stay," the authors examine current uses and needs for computers in the classroom, the need for a definition of computer literacy, and gaining high tech acceptance. Exploring the "people side" of high tech, section 4 focuses on computer-aided instruction and professional development. Section 5's "action agenda" for creating high tech schools makes step-by-step recommendations for program implementation and discusses the role of the principal in realizing each step. The document concludes with a list of EPCOT conference participants. (JBM)

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HIGH TECH SCHOOLS

THE PRINCIPAL'S PERSPECTIVE

EA 016 720

NATIONAL ASSOCIATION OF SECONDARY SCHOOL PRINCIPALS

High Tech Schools: The Principal's Perspective

National Association of Secondary School Principals
Reston, Virginia

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National Association of Secondary School Principals
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Foreword

The 16 years remaining in this century may present American education with the most critical challenges and dramatic changes in its history. The brilliant spotlight cast on U.S. education by a dozen national reports and studies has already set the stage for an intense examination of the nation's schools.

Another illuminating source, however, may ultimately be the force that most determines the direction education takes during the next several years. That source, unclearly perceived, is the powerful contemporary transformation of society referred to as the Information Revolution.

Characterized by global economics, decentralization of information and political power, demographic shifts, and most significantly by major technological advances, the Information Age is imploring — and soon will demand — that our schools "keep step with the times." As this publication suggests, the widespread changes already begun, along with others to come, hold dramatic implications for educators.

In December 1983, a group of the nation's most distinguished experts in the fields of technology, communications, education, and trend analysis joined with 46 secondary school principals from across the country at EPCOT to examine Information Age developments as they relate to the future of education in our increasingly "high tech" world. Presented here are their collective thoughts on "what lies ahead for schools," and on what educators, especially principals, can do to prepare for what lies ahead.

With due consideration of the nation's renewed focus on schools and considering the clamor to bring technology into the classroom, the principals delved into the projections for American education during the next five years and concluded, "Yes, some major changes are upon us."

Yes, educators need to survey the world outside the schoolhouse to modernize the teaching and learning that takes place inside.

Yes, the rapidly changing job market requires some equally rapid changes in the ways schools prepare students for the workplace.

Yes, the roles of superintendents, principals, and teachers need some adjustments to meet the future's demands on education.

And yes, the electronic classroom is both an enduring and potentially revolutionizing development for education.

Furthermore, one aspect of the future is certain: Education will assume a new degree of importance in the years ahead — so important that it will be regarded as a mainstream activity for every age group and sector of the society.

After examining the anticipated impact of the Information Age on education and assessing existing capabilities of schools to adapt to the required changes, the principals suggested directions and actions that are needed to better align schooling with emerging trends, with shifts in the labor market, and especially with the technological developments that not only require education to change, but also serve as an important tool for educators to make those changes effectively.

Their recommendations focus on five major areas: educational planning, school curriculum, professional development, finances, and the formation of school improvement partnerships. Furthermore, included in each of these areas are ideas concerning how principals can assist in implementing the recommendations.

The role of the principal in meeting education's new challenges must not be underestimated; principals are in a unique position to take responsible action for keeping schools current and by providing new opportunities available to students.

"Just as the Information Age did not appear on the world scene overnight," commented one principal, "education's response to that transformation will not be automatic. But," he added quickly, "the school principals — one by one, if necessary — can ensure that a solid, meaningful response is made."

Or, as another principal remarked, playing on the phrase made famous in the Pogo comic strip: "We have met the future and it's up to us!"

The EPCOT symposium, which allowed this publication on "High Tech Schools," was made possible by grants from the Danforth Foundation and Burger King, Inc. It was planned by NASSP and cosponsored by the Walt Disney World Corporation and by *Learning Trends* report. We extend our deep appreciation to all who made the symposium and this publication possible. We believe it answers the question, "What happens after the national reports?"

Scott D. Thomson
Executive Director
NASSP

The Demands of an Information Age

"The economy of the world is being restructured on the energy of the microchip."

—Shirley McCune

"We (educators) have to recognize what is outmoded and simply let go of the antiques."

—EPCOT principal

"Schools have to be the glue of our society; they are our greatest means of social stability."

—Shirley McCune

ONE WAY TO RIGHT WHAT IS WRONG with education today is to simply "fix up" our schools, to find better ways of doing what schools have traditionally done. However, past education practices may not always be compatible with the demands of the future.

An emerging view about solving education's troubles is founded on a very different set of assumptions — assumptions that are based on regarding educational institutions, not as isolated entities, but as players in a worldwide pattern of change. The current changes in the economic, social, and political sectors of the nation are so profound that the schoolhouse doors can no longer bar their entry. Schooling and its "pencil and paper" approach to learning has remained virtually unchanged in 200 years, but fundamental upheavals in the society and culture of the country require some new educational outlooks.

Education, therefore, will be improved by looking to the larger society, understanding the ongoing transformations, and restructuring schools to align with the evolving needs of the Information Age.

Evidence that America *is* changing rapidly abounds. A number of distinct trends not only illustrate the change, but tend to work in

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This chapter is based on the remarks and writings of Shirley McCune and Harold Hodgkinson.

concert to accelerate the changes. Furthermore, each of these trends point to the need for some serious revamping of the nation's educational systems.

From an Industrial to an Information Workforce

Today, only 13 percent of the workforce is employed in industrial jobs. Less than 25 years ago, 55 percent of the nation's workers made their livelihoods from manufacturing and industry. Information, however, has replaced the mills, factories, and plants as the country's primary employer. In 1950, only 26 percent of the labor force was involved in the processing and handling of information. Currently, almost 65 percent of all workers draw their paychecks from information-related jobs.

This dramatic change from industrial jobs to information-related employment occurred in less than 30 years; the equally significant turnover from an agricultural society to the industrial age took almost 100 years. This increased pace of change alone plays havoc with social institutions such as education, which notoriously lag far behind economic and employment events.

Undoubtedly, one of the primary functions of education is to prepare young people for the world of work. As the nature of work has changed and is changing, different knowledge, skills, and abilities are required for the jobs available. Responsibility for imparting this new learning lies with the schools — schools that in most cases are still operating under the false belief that the skills "taught our fathers" will adequately serve today's children in their future careers.

While training for particular manual trades or specialized professions may have suited the needs of industrial America, the Information Age demands a broader base of knowledge from its workers. The persistence of schools in teaching students the skills of rapidly disappearing jobs is evidence that education confronts a major job of catching up to the realities of the workplace.

Students of the information age not only need an increased ability to function in a technological world but also must be prepared to work more independently, solve more complicated problems, and continue to expand their intellectual capabilities and skills throughout their lifetimes.

From a National to a Global Economy

The phrase "no man is an island" applies to countries as well. While many cling to the notion that the United States remains stead-

fastly a self-sufficient, economically independent nation, an irrefutable trend of increasing reliance on the world economy has emerged.

Before 1970, America's involvement in world trade was minimal. Only 9 percent of U.S. goods were exported, balanced by the sales of imported goods also totaling only 9 percent. A decade later, however, the percentage of exported goods had jumped to 17 percent and imported goods accounted for 21 percent of American sales. Imports comprised nearly a quarter of the total growth in American sales over the last 10 years.

Furthermore, the statistics on productivity show a changed economic balance. Although the United States retains first place among all nations in the amount of productivity, it ranks only eighth in measures of productivity growth. If this pattern of reliance on imports over exports continues to increase and the level of new productivity declines further, the U.S. will face future waves of unemployment, a reduction in the American standard of living, or both.

Strident calls to "buy American" or a return of 19th century isolationism will not reverse this trend of global interdependency; increasingly limited natural resources and vastly variant labor prices will require a "shared" economy among countries. However, the key to limiting the potential negative effects of a too dependent existence may lie in turning American attention to the increased provision and exportation of those goods and services which other nations cannot produce. In most instances, this means focusing on the development of high technology — the commodity in which the U.S. can continue to excel and which other countries will increasingly seek.

If a global economy is indeed a new fact of life, and if survival in that economy is dependent largely upon America's ability to offer the world successive generations of better and better technology, the role which education must play in this scenario is considerable.

The charge to develop the new technologies will fall upon the students who are in the nation's classrooms now. Thus, these young people must be able not only to operate existing electronic wonders but must also be the inventors of the "miracles" to come, a premise that supports the continuing need for exceptional math, science, and problem-solving training at the pre-college level.

Additionally, as global involvement continues to accelerate, the nation's need for citizens able to understand other cultures and communicate with other nations also becomes acute. Two of the obvious

strategies for education to meet this need are to increase the country's multi-lingual capabilities and to emphasize the in-depth study of other cultures.

From a Centralized to a Decentralized Society

For the past three decades, the notion that "bigger is better" has been on the wane. Accompanying this trend has been a strong movement away from the centralization of government, businesses, unions, and social institutions. Businesses have adopted the "franchise" approach or have divested headquarters' responsibilities to widely scattered local offices and branches of operation. Health care has been transferred from major institutions to clinics, health maintenance organizations, hospices, and the like. And perhaps most noticeably, federal governmental power has been disseminated to state, county, city, and neighborhood control.

Education has only lately boarded the decentralization movement. The launch of "effective schools" research in the 1970s prompted educators to begin viewing the local school, rather than the district as a whole, as the unit where improvement efforts should start.

As the decentralization of society's institutions continues, the demand for a more localized examination of education is likely to increase. Already, education's spectators and critics are looking more to school principals and less to the superintendents as the source of instructional leadership.

This decentralization trend will require even further changes in the educational structure in the years ahead. As school leadership focuses more on principals, classroom teachers will be viewed increasingly as instructional managers and planners, not merely agents for delivering educational services. The widespread emphasis on local decision making will be mirrored by a demand for fewer "top-down" decisions in education matters. These changes will require school systems to allow for more autonomous individual schools that can tailor educational services to the needs of their respective communities.

These changes will require superintendents to assume more responsibility as community brokers, goal formulators, resource providers, and evaluators of results. Consequently, school boards will not be solely community servants, but a kind of "board of directors" for multi-million dollar businesses. The central office then becomes the goal setting and planning arm for the district's schools, serving increasingly as the manager of *change* — the most constant staple of the information society.

From an Either/Or to a Multiple Option Society

In the not-too-distant past, Americans' television viewing was limited to choices among three networks. With the advent of cable and independent television stations, television watchers in several parts of the country now have available from 30 to 120 channels. Likewise, in the 1940s, popular magazine readers had only three national choices: *Life*, *Look*, or *The Saturday Evening Post*. Today's newsstands carry almost 5,000 national publications tailored to the specific tastes and interests of everyone from joggers to home decorators and from punk rock fans to stock analysts.

The movement from limited choices to multiple options is by no means confined to the entertainment and publishing industries. In virtually every aspect of American society, an array of products or services has proliferated where once only one or two choices were available. The food industry is an obvious example: once corn flakes and shredded wheat were the cereal selections of most households, now entire aisles of grocery stores are lined with the latest in "raspberry-coated crunchies" and "all-natural guru granola."

Health care also was an either/or proposition not too long ago. A visit to the family doctor or a stay in the hospital were the only available medical options. Today, people choose from neighborhood clinics, a seemingly endless list of specialized doctors, paramedics, midwives, nursing homes, walk-in surgery centers, etc.

Education, too, was previously a forced-choice operation. Students either elected, or were selected, to enter "academic" or vocational tracks of study. The high school curriculum was divided between those going to college and those going to work. Recently, however, multiple options have become a requirement to meet the diversity of educational needs. Magnet schools, college level courses, collaborative business-education programs, community service training, continuing education, equivalency programs, bilingual schools, alternative schools, and home instruction are only a few of the choices available to students.

Postsecondary education was provided by only two sources: the public universities or private colleges. Today, the places providing education and training are as varied as the subjects being taught. The military, government, nonprofit organizations, and businesses also are dispensers of higher education. The corporate world spends as many dollars on education and training as does all of higher education, both public and private.

Currently 14 corporations run their own colleges and offer degrees. The American Management Association alone offers hundreds of training classes and workshops each year. More than 10 million working adults are enrolling in 18 million different courses each year. Adult education now is estimated at a $40 to $50 billion-a-year business. An aging population and the need for periodic retraining in "high tech" job fields will propel demands for adult education to new heights in the coming years.

Early childhood education is also feeling the pressure from society's demand for multiple choices. As more and more women entered the workforce, the need for day care and preschool services skyrocketed. Social service agencies and churches have rallied to try and meet the need but cannot accommodate the still growing demand. Recently, the private sector has begun to enter this aspect of education; ARA, a national vending machine company now operates 25 day care centers and Kentucky Fried Chicken is launching its own day care "franchises."

Not surprisingly, elementary and secondary education — once the sole province of public, and some private, schools — will also be affected by the public's expectations and calls for multiple options. In January 1984, three Chicago entrepreneurs announced their intention to open a chain of for-profit elementary schools. They plan to open two schools in September 1984 and from 2 to 10 schools a year thereafter.

Clearly, the nation's school systems need to recognize not only the growing demand for choices in education, but also that if the traditional means of education cannot provide the desired choices (or standard of quality), other institutions and businesses will devise ways of satisfying the public's wishes.

From the "Melting Pot" to a Culturally Diverse Society

Perhaps one of the most overlooked or ignored changes in American society is the increasing number and diversity of racial and ethnic groups. American society in general, and education in particular, continues to think in terms of "minority" concerns. Yet, demographic changes in the population strongly indicate the need for new conceptual views of so-called "minority" groups.

Eighteen of the 20 largest school systems in the nation have minority student enrollments of near or more than 50 percent. Three of the largest states will soon have a majority of "minority" students: California, Texas, and Florida. More than one-half of the

states have a public school population of 25 percent or more minority students.

Minority student populations will continue to increase. The recent influx of people from Mexico, Central America, and the Caribbean nations will add to the Hispanic student population.

Although some considerable progress is now being made, the nation's schools have historically faced serious problems in providing quality education for minority and low-income students. Achievement scores among these groups, for example, continue to lag behind those of the white and more affluent students. As the number of minority students grows, the imperative for schools to teach heterogeneous groups of students becomes all the more urgent.

In the more long-range view, the education and subsequent employment of minority youth takes on particular importance for the economic stability of the nation at large. Ninety percent of those who will be in the workforce in 1990 are already at work today. Thus, a substantial number of workers will be nearing retirement age in the years ahead. Retiring workers will find themselves increasingly dependent on a workforce heavily composed of minorities to maintain retirement trust funds.

As minority students graduate into the labor market, employers will become more dependent on minority students to fill the job openings created by the retiring population. The quality of education these minority students receive today becomes a critical factor in their future ability to sustain tomorrow's labor market needs — needs which will be of an increasingly skilled technical nature.

From the East to the Sunbelt

Just as the end of the baby boom caught school systems off guard with declining student enrollments and empty classrooms, demography today is playing havoc with education planners. By the end of the 1970s, the birth rate started upward again, but not consistently throughout the country. The South and Southwest are the primary beneficiaries of the newer so-called baby "boomlet."

Thus, the nation is confronting a dual set of educational problems: The Sunbelt areas of the country must now provide more educational facilities and services for children entering school while the northern states must continue to cut back on such services and find creative uses for underused or empty buildings.

To complicate education's demographic dilemma further, the decline in student population which elementary and secondary schools experienced in the 1970s is now hitting the country's colleges. Higher education will face smaller high school graduating

classes until 19[illegible]. For many institutions, this means devising means of keeping financially alive for 16 years until the number of high school graduates is on the upswing again. Gearing down educational programs, staying economically afloat in an extended period of "lean years," and then gearing up again are substantial undertakings, even given a degree of forewarning and early planning.

From Mom and Dad to Single Parent Families

Dramatic changes in the composition of the American family have and will continue to require schools to make further adjustments in their structures and services.

Although the rapid and significant entrance of women into the labor force during the last few decades was a major change in family life, the education system has not yet begun to respond fully to this phenomenon. The rise in two-earner families created an enormous demand for infant day care services, and after-school care programs for school age youngsters and agencies outside the schools were left virtually alone in trying to satisfy the early needs.

However, as the number of mothers working outside the home continued to burgeon, schools were increasingly asked and expected to provide before and after-school care services. The number of working mothers is expected to increase, as is the pressure on schools not only to provide custodial care to the children outside of school hours, but also to offer bona fide educational programs during these times.

Another change in family life is just beginning to make its full force felt in the nation's schools: the unprecedented high rate of divorce. This trend, while expected to lessen slightly, will continue at a relati[illegible]y high rate. The 1980 census indicates that a full 48 percent of the children born in 1980 will be raised by a single parent.

A growing body of research reveals that children from single-parent families exhibit more learning difficulties than do students from two-parent homes. Additionally, the very high frequency of homes headed by a single parent and those in which both parents work have diminished the amount of parental involvement with their children's schools. Many schools persist in making few, if any, concessions to these changes in their students' homes. For example, many schools, often due to teacher contract provisions, still require parent-teacher conferences to be scheduled during traditional work hours.

The Implications of These Changes

Although these trends do not comprise an exhaustive list of the

changes which are accompanying the nation's transformation to an information society, they are some of the major factors that make a persuasive case for why education as conducted in the past is out of step with the needs of today and the future. This shifting economic, social, and political context requires education, like the nation's other institutions, to make a series of fundamental changes.

While the need for such changes is immediate, major alterations in social institutions historically have been evolutionary and not overnight transformations. Changes in education will continue to be uneven and based on previous structures, norms, and expectations. Therefore, in adapting education to the demands of a new age, educators must take care to plan both long-term directions for a fundamental restructuring of schooling and short-term approaches for immediate improvement.

As school systems prepare to address the educational needs of the Information Age, there are at least six areas requiring examination which may serve as a framework for long and short range planning:

- The goals of education;
- The delivery systems for educational services;
- The roles for educational personnel;
- The assessment and evaluation of education;
- The financing of education;
- The quantity and quality of community outreach.

Examples of some needed directions in each of these areas appear below. These directions for education represent changes which employ existing structures, programs, and personnel as a base for improvement; they are not intended to suggest a total replacement or wholesale abandonment of past or current educational practices and policies.

This framework provides an initial overview of the directions education must take to keep up with the tumultuous changes that are accompanying the onset of the Information Age. Resistance and disagreement with some of these directions is inevitable. A debate about how to best improve education prompts probably more varied and contradictory opinions than any other contemporary public issue. The primary value in analyzing societal trends and proposing possible directions to address the consequences of those trends is to clarify areas of public concurrence and to spur on the necessary planning processes. The anticipation of potential problems and changes remains American education's best strategy to avoid crises and to successfully fulfill the mission of providing quality education to all.

Directions for Education

Area	In An Industrial Society	In An Information Society
Goals of Education		
Cognitive Goals	Basic skills	Higher order skills and basic skills
	Specific training	Generalizable skills
	Unicultural	Global education
	Literacy	Many literacies, more than one language
Affective Goals	Large organization skills	Small group skills
	Organization dependent	Independent entrepreneurial
Curriculum	Learning simple discipline skills	Interdisciplinary programs
	Standardized programs	Varied program options
	Computer as a vocational skill	Computer as learning tool in all programs
Job Preparation	Single-career preparation	Multiple-career preparation
	Late skill development	Early skill development
	Distinct vocational education programs	Career/vocational education as integral part of educational experience
Delivery Systems		
Changing Institutional Patterns	Single district system focus	More variety at building level
	Central office management	School based management

Area	In An Industrial Society	In An Information Society
	Top-down, insulated decision making	Bottom-up, participative decision making
	Group instruction	Individualized instruction using technology
Changing Methodologies	Traditional instructional methods	Expanded instructional methods
	Instructor/print-based systems	Technology-assisted systems
	Computer-assisted instruction	Computer-cable-networks-robots-telecommunications technologies
Education Personnel		
Expansion of Current Roles	Teacher as subject-matter expert	Teacher as manager of information and resources
	Teacher as standards-setter	Teacher as self-concept developer
	Teacher as deliverer of services	Teacher as instructional manager and planner
	Principal as middle manager	Principal as educational leader, staff developer, and neighborhood liaison as well as manager
	Principal as central office conduit	Principal as program entrepreneur
	Superintendent as preserver of tradition	Superintendent as future-oriented planner (manager of change)
	Superintendent as educational leader	Superintendent as community broker, goal formulator, resource provider, and evaluator
	School board as community servants	School board as directors of essential public services

Area	In An Industrial Society	In An Information Society
New Roles	Textbook and software industries as supplier and resource developer	Computer software development staff who supplement and tailor software to local needs
Financing of Education		
Rationale and Scope	Individual development (schooling) Limited support for youth services Education as an expenditure	Economic development (forming human capital) Expanded support for total population services Education as an investment
Sources of Funds	Local taxes Public tax funds Schools as limited revenue-producing institutions	Continued expansion of state funding Extended business support and user fees Education-related functions and services to produce revenue
Distribution of Funds	Equalization of funds among districts Undifferentiated salaries Single plan of employee benefits	Greater emphasis on incentive funding tied to district performance Base salaries with incentives Menu of employee benefits
Community Outreach	Business as consumer of educational products Time-limited programs School as only learning site School district: youth oriented Parent as passive consumer	Business as participant and learning resource Flexible, continuing education services School/home/business learning sites School district: life-long learning oriented Parent as active consumer/decision maker

The Future World of Work

"Schools can't continue to train kids for jobs that won't exist in 10 years."

—Marvin Cetron

"Career training should adopt businesses' motto: Innovate and automate, or evaporate."

—Marvin Cetron

"Education's challenge is to upgrade the scientific, technical, and computer skills of the future labor force."

—EPCOT principal

ONE THING IS CERTAIN ABOUT TOMORROW'S job markets: dramatic shifts will occur in employment patterns.

Major shifts in the job market won't necessarily mean major changes in the numbers of people employed. What the changes do mean is that many of the old jobs will disappear — and not just because of robots and computers. Manufacturing will provide only 11 percent of the jobs in the year 2000, down from 28 percent in 1980. Jobs related to agriculture will drop from 4 percent to 3 percent. The turn of the century will find the remaining 86 percent of the workforce in the service sector, up from 68 percent in 1980. Of the service-sector jobs, half will relate to information collection, management, and dissemination.

NEW OCCUPATIONS FOR THE 1990s

The following occupations are among those that are expected to become increasingly important:

- *Energy Technician* (650,000 jobs) jobs will increase dramatically as new energy sources become marketable.
- *Housing Rehabilitation Technician* (500,000 jobs). Intensifying housing demand will be met by mass production of prefabricated

This chapter is based on the remarks and writings of Marvin J. Cetron and Harold Hodgkinson.

The Shifting Job Market

Some jobs that will be disappearing by 1990:

Occupation	% Decline in Employment
Linotype operator	−40.0
Elevator operator	30.0
Shoemaking machine operators	19.2
Farm laborers	19.0
Railroad car repairers	17.9
Farm managers	17.1
Graduate assistants	16.7
Housekeepers, private household	14.9
Childcare workers, private household	14.8
Maids and servants, private household	14.7
Farm supervisors	14.3
Farm owners and tenants	13.7
Timber cutting and logging workers	13.6
Secondary school teachers	13.1

Some jobs that will be growing until 1990:

Occupation	% Growth in Employment
Data processing machine mechanics	+157.1
Paralegal personnel	143.0
Computer systems analysts	112.4
Midwives	110.0
Computer operators	91.7
Office machine service technicians	86.7
Tax preparers	77.9
Computer programmers	77.2
Aero-astronautic engineers	74.8
Employment interviewers	72.0
Fast food restaurant workers	69.4
Childcare attendants	66.5
Veterinarians	66.1
Chefs	55.0

Source: *Encounters with the Future,* Marvin Cetron and Thomas O'Toole (New York: McGraw-Hill, 1982).

modular housing, using new construction techniques and materials.

- *Hazardous Waste Management Technician* (300,000 jobs). Many years and billions of dollars may be required to clean up air, land, and water.
- *Industrial Laser Process Technician* (600,000 jobs). Laser manufacturing equipment and processes, including robotic factories, will replace much of today's machine and foundry tools and equipment.
- *Industrial Robot Production Technician* (800,000 jobs). Extensive use of robots to perform computer-directed "physical" and "mental" functions will displace hundreds of thousands of workers. But new workers will be needed to ensure fail-proof operations of the production robots.
- *Materials Utilization Technicians* (400,000 jobs) must be trained to work with new materials being engineered and created to replace metals, synthetics, and other production substances unsuited for advanced manufacturing technologies.
- *Genetic Engineering Technician* (250,000 jobs). Genetically engineered materials will be used extensively in three general fields: industrial products, pharmaceuticals, and agricultural products.
- *Holographic Inspection Specialist* (200,000 jobs). Completely automated factories that use optical fibers for sensing light, temperature, pressure, and dimensions will transmit this information to optical computers to compare this data with stored holographic (three-dimensional) images.
- *Bionic-Medical Technician* (200,000 jobs). Mechanics will be needed to manufacture bionic appendages while other specialists work on highly sophisticated extensions of sensory and mental functions.
- *Automotive Fuel Cell (Battery) Technicians* (250,000 jobs) will perform tests and services for new fuel cells and batteries used in vehicles and for stationary operations, including residences.
- *On-Line Emergency Medical Technician* (400,000 jobs). Need for paramedics will increase directly with the growth and aging of the population.
- *Geriatric Social Workers* (700,000 jobs) will be essential for the mental and social care of the nation's aging population.
- *Energy Auditors* (180,000 jobs) will use the latest infrared devices and computer-based energy monitoring to work with architects, product engineers, and marketing staffs in the production, sales,

and operation of energy conservation and control systems for housing, industrial plants, and machinery.

- *Nuclear Medicine Technologists* (75,000 jobs) will work with medicines and serums using radioisotopes. As the isotopes are absorbed in tissues and muscles, diagnosticians can observe functions of normal and/or damaged tissues and organs and can determine treatment needs and responses to medication, thus reducing the need for surgery.
- *Dialysis Technologists* (30,000 jobs) will operate new portable dialysis machines and the expected greater number of hospital dialysis machines.
- *Computer Axial Tomography (CAT) Technologist/Technician* (45,000 jobs). Though more than a decade has passed since development of this technique for using X-rays with computer technology to give sectional views of internal body structures, the supply of qualified technicians has not kept pace with the growth of the technology. Jobs for technicians to install, maintain, and operate CAT scanning systems and assist in the analysis of these scans will offer employment for thousands of qualified people.
- *Position Emission Tomography (PET) Technician/Technologist* (165,000 jobs). PET scanners are used for diagnoses of disorders of the brain. The need for qualified workers in this field will increase with the growing use of this technology.
- *Computer-Assisted Design (CAD) Technician* (300,000 jobs). These workers will use computers to design modes of transportation, buildings, and a host of other products.
- *Computer-Assisted Graphics (CAG) Technician* (150,000 jobs). Rapid growth of computer-assisted graphics will increase the demand for artists and technicians tenfold.
- *Computerized Vocational Training (CVT) Technicians* (300,000 jobs) will be employed to develop educational and training materials to use in programs at all levels in public and private educational institutions.

Another Side of the Jobs Outlook

These new technology-related jobs are only a partial picture of the labor needs for the 1990s. While high tech will bring about the creation of new jobs and careers related to computers, robots, lasers, and the like, the areas of greatest growth will be in jobs that require no more than a high school education. Furthermore, the application of technology to the workplace is likely to reduce the skill requirements of many job categories.

For example, the Bureau of Labor Statistics projects 200,000 new jobs for computer systems analysts by 1990, but more than 600,000 new slots are expected for janitors and sextons. While 150,000 new jobs for computer programmers will emerge, about 800,000 new jobs for fast food workers and kitchen helpers are anticipated.

Although many technology-related occupations are growing more rapidly in percentages, they represent a relatively small share of the total employment needs. By 1990, only about 7 percent of the workforce will be employed in the very highly technical jobs; five out of six workers, however, will be in clerical and service jobs such as waiters, waitresses, salespeople, janitors, security guards, cashiers, and cooks.

What does this dual outlook on the workforce mean for education? How can schools fulfill their goal of preparing young people for the careers and jobs of the future? On one hand, the Information Age is demanding advanced, new skills for emerging technical careers and on the other, the application of technology to existing kinds of jobs is lowering the level of skills needed.

Preparation for the 21st Century

To determine the schools' most effective role in preparing students for their future lives in a high tech world, educators must examine these labor market projections in conjunction with two other areas: the changing society's impact on personal lives and citizenship.

The increase in life expectancies and the predicted shortening of the traditional work week, for instance, will afford most people a great deal more free time. This change will create a need and demand for education in leisure time activities and productive "after hours" pursuits.

Citizenship education has long been a function of the nation's schools. This aspect of education will become even more important as students face an increasingly complex and technical world. For citizens to participate fully in their democratic institutions, they will require a more thorough understanding of the historical, scientific, and technical aspects of their nation. As noted earlier, the growing interdependency of nations around the globe also will require a citizenry that can communicate with and understand various cultures.

As the types of jobs change, so will the definition of full employment. Currently, a 4.5 percent unemployment rate is considered full employment. But by 1990, 8.5 percent unemployment will be considered full employment. This figure may not be as disturbing as it

first appears, for at any given time 3.5 percent of the workforce will be in training and education programs preparing for new jobs.

Workers will be able to take time out for retraining, in part, because of the shift in job patterns. In 1980, 45 percent of American households had two people working. By 1990, this proportion will increase to 65 percent, and by 2000, 75 percent of family units will have two incomes. This shift will allow easier transitions from the workforce to training programs and back to the workforce. Forecasts predict that every four or five years one of the partners will leave the ranks of the employed to receive the additional knowledge and skills demanded by changes in technology and the workplace.

Under these conditions, the most important work preparation that education may provide is a basic foundation which equips people to successfully adapt to change. As important as math, science, and career skills are, they are not enough for tomorrow's world. As society changes, so will the skills and knowledge needed for individual productivity and satisfaction. The higher levels of cognitive skills must be learned — and learned as early in life as possible. People will need skills in decision making, problem solving, creativity, critical thinking, evaluations, analysis, and synthesis.

Furthermore, the importance of communication abilities will increase in the coming years. Reading, writing, speaking, listening, and the capability to interpret written or spoken material are skills which will be essential to all jobs in the future.

Job Skills for 1990

1. Evaluation and analysis
2. Critical thinking
3. Problem solving (including math)
4. Organization and reference
5. Synthesis
6. Application to new areas
7. Creativity
8. Decision making with incomplete information
9. Communication skills in many modes

Source: *Information Society*, Denver, 1982.

Completing the agenda which the changing job scene has set for education is a monumental undertaking. Keeping career training programs up to date has always been a problem for education. The rapid pace of technological change accentuates and widens the gap between programs and the cutting edge of knowledge. Furthermore, maintaining the necessary skilled workforce will require an enormous expenditure of resources.

Schools do not carry the burden of developing the workers of the future alone. Business and industry are also steeped in the problem of how to train, retool, equip, and prepare a labor force capable of meeting the challenges of the increasingly technical jobs. And, as many educators and businessmen are discovering, this mutually shared problem may best be tackled by joining forces.

Largest Numbers of New Jobs

OCCUPATION	GROWTH IN EMPLOYMENT IN THOUSANDS, 1978 - 1990
JANITORS AND SEXTONS	671.2
NURSES AIDES AND ORDERLIES	594.0
SALES CLERKS	590.7
CASHIERS	545.5
WAITERS/WAITRESSES	531.9
GENERAL CLERKS, OFFICE	529.8
PROFESSIONAL NURSES	515.8
FOOD PREPARATION AND SERVICE WORKERS, FAST FOOD RESTAURANTS	491.9
SECRETARIES	487.8
TRUCK DRIVERS	437.6

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PARTNERSHIPS FOR SUCCESS

U.S. businesses spend an estimated $60 billion annually on training employees, and a large percentage of that amount is spent simply to upgrade employees' basic skills. American Telephone and Telegraph, for example, spends an estimated $6 million a year to teach 14,000 employees basic writing and arithmetic during office hours. Metropolitan Life Insurance devotes more than 40 percent of its training and development dollars to teaching English usage and general mathematics.

Even greater amounts of money are spent on employee recruitment, hiring, and turnover costs. In one year, General Motors hired 9,000 workers to fill 1,500 jobs. Most entry-level training programs in corporations are not cost-effective, according to the business executives, because too few employees keep their jobs longer than it takes to reach the break-even point of their training costs.

Thus, a "shadow" education system is operating in the business world. Corporate resources are being poured into remedial education — an unnecessary expenditure if schools were providing better trained individuals.

Given this situation, some school districts are now urging businesses to replace their remedial education costs with investments in basic education through their local schools. By supporting improvements in schools, these educators contend, corporations can expect to profit from an improved labor force, lower training costs, reduced turnover rates, and more productive employees.

Consequently, schools and businesses are forming partnerships based on the notion that both parties have some common goals — the preparation of a better trained student/employee — and that by pooling resources, education and the private sector can jointly design training and education programs which result in success for both partners.

In launching such partnerships, schools are acknowledging that they may benefit from the private sector's expertise in management, program development, and applications of new technologies. Similarly, the business partners are recognizing and calling upon education's fortes: teaching, counseling, and human development.

The principle behind this and other emerging forms of collaboration is one of simple exchange: "You have things that I need and I have things that you need, and so we trade." Thus, rather than raising funds to get the necessary equipment, expertise, etc., the collaborating parties are raising resources directly.

Collaboration can take many forms. Many schools and colleges

have resources that others would be happy to pay for — from food services to book stores to conference rooms to office space to teaching new courses. For example, one high school principal in Indiana has 900 students during the day, and 1,200 adult students at night. The school discovered that many adults had educational needs that were not being met and that the 1,200 adults were more than willing to pay a fee for the services they needed. As a result, the school budget now has a surplus that is being used to develop new programs for the regular day students.

Computers: Both the Cause and the Solution

A curious irony can be found in any examination of job prospects for the future. A major reason why education must now adopt new approaches to preparing tomorrow's workers is that computer technology is radically changing the employment scene in this nation. At the same time, it is the computer and its many applications that may enable education to successfully meet the challenge of developing that new workforce.

Computerized training and instruction, as the next section presents, holds the potential for lessening education costs in the long run, freeing teachers for more direct student interaction, and at the same time, improving the quality of educational programs.

High Tech Is Here To Stay

"The difference between winners and losers is not who has the information but who knows how to use it."

—David Moursund

"We don't have enough time to cram our heads with learning things that a machine can do better."

—David Moursund

"Defining computer literacy is like shooting at a rapidly moving target."

—David Moursund

"In the world of high technology, the message is clear: We ain't seen nothing yet!"

—David Moursund

THE SINGLE MOST IDENTIFIABLE REASON FOR America's transformation from an industrial society to an information society is the computer. For education, the computer is the most promising — and provoking — new tool since the invention of the printing press.

On the plus side, computers as well as interactive cable and microwave communication systems, may hold the potential not only for accelerated student learning but for great gains in management efficiency as well. In school administration, the assistance of computers is being called upon for keeping student attendance and grade records, handling employee payrolls, maintaining equipment and supply inventories, scoring tests, developing and monitoring budgets, etc. Nearly all the applications that sold business on the necessity of computers in management are now being adapted for use in the administrative side of schooling.

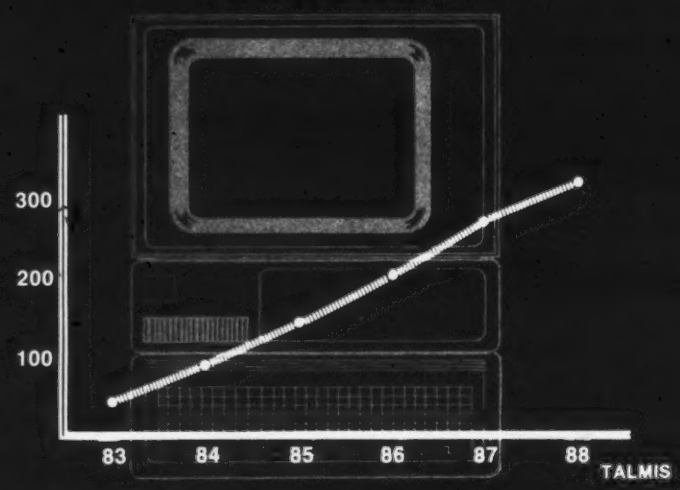
This chapter is based on the remarks and writings of David Moursund and Harvey Long.

However, the real excitement about computers in education lies in the array of possibilities which the technology holds for enhancing instruction and learning. The list of potential uses only begins with "computers as a means of developing and practicing basic skills." Instructional uses of computers, while not yet widely used in these ways, also include: teaching of advanced subject matter; exploring art and music theory; retrieving information from vast data bases; simulating social environments and scientific principles; teaching writing by word processing; stimulating creative problem solving and analytical thought; and prompting student-written programs to further extend the computers' usefulness.

Computer technology is a powerful aid to solving education problems, but it is currently also a source of powerful problems. While most school systems are scrambling to climb on the electronic bandwagon, lured both by the hope of dramatic gains in student achievement and by the fear of shortchanging their students' abilities to compete in the future labor market, a barrage of serious dilemmas are accompanying the introduction of computers to the classroom.

The almost fanatical pressures — from parents, students, the public at large, and computer companies as well as from educators themselves — to accelerate the acquisition and use of high

ELEMENTARY/SECONDARY MICROCOMPUTER SOFTWARE SALES



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technology in education have left schools in the unenviable position of making major purchases of computer equipment while lacking: knowledge of how best to use the technology; time for planning a comprehensive or systematic approach to its use; a well-trained corps of teachers who can use the equipment; and historical precedents or prototypes to help guide the uses.

Additionally, most school districts are steeped in debates over how to find the money not only to pay for hardware and courseware, but also for the costly repair and maintenance contracts and the added staff training expenses. Even those school districts with substantial funds to launch systemwide technology efforts are concerned that student access to the technology will be limited by high pupil-to-computer ratios.

However, despite the myriad of complex, unsolved issues surrounding educational technology, the potential rewards and gains of employing computers in instruction appear to have convinced most school administrators that the electronic classroom is a necessity and that the training, financing, access, and equity concerns can all be resolved over time.

Indeed, the sheer numbers of computer and computer related purchases by school systems is evidence that many educators have great confidence in the computer as a vital learning tool. In 1983, the nation's elementary and secondary schools spent about $40 million just for microcomputer software, and that figure is projected to jump to $300 million by 1988.

Parents seem to be among the strongest voices calling for technology's admission to daily education. While recent public opinion surveys indicate general support for increased school budgets, parent groups are increasingly pushing for added school revenues specifically to pay for more computer technology.

A Passing Fad or Education's Newest Ally?

Despite the recent clamor for schools to buy more and more microcomputers for classroom use, will these electronic tools really make a sizable impact on education?

Although many educators caution that the computer's entry into the classroom is too recent to conclusively predict the full consequences of educational technology, most current research indicates that computer-assisted instruction can significantly enhance student learning. Studies conducted as early as the 1950s concluded that computers could be an important aid to learning, but the notion was largely discounted at that time due to the then-exorbitant costs of such instruction.

More recent studies have focused primarily on the use of computers for drill and practice exercises in reading and mathematics and have concluded that this application is particularly effective. The computer's infinite patience, lack of judgmental feedback, and individualized approach to each learner are major features which contribute to students' success. Drill and practice via the computer has proven especially helpful to students who are below grade level in their abilities.

Computers are emerging as especially useful in helping handicapped children. Physically handicapped students use computerized systems to aid in communication and in gaining access to information. The voice input and voice output devices now available are opening up new means of learning for such students.

The basic areas of schooling are by no means the only arena in which the computer is emerging as a powerful helper. While some educators believe computer programming to be too advanced for the pre-college curriculum, others contend that it is not that high school students don't have the mathematical abilities to handle programming concepts, but that by teaching programming in a simple computer language and emphasizing problem-solving steps, students can better learn the math skills now popularly viewed as necessary prerequisites to the study of programming and can correct many other weaknesses in their math skills.

As the evidence mounts in favor of computer-aided instruction, many teachers and administrators are beginning to regard the computer as a learning tool as fundamental as paper, pencils, and books. Certainly, like the pencil and paper, a computer is an interactive medium. Like books, it can store printed information. But the functions of the computer also extend beyond these capabilities; computers can automatically and rapidly follow a detailed set of instructions involving the input, storage, manipulation, and output of symbols. Furthermore, computers can minimize the time-consuming "by hand" or rote aspects of learning and thus, enable students to spend more time on thinking and understanding.

Even those sectors of the education community that are urging a cautious approach to melding computers and instruction seldom deny the computer's potential for contributing to students' learning. Most of these critics are merely warning against revering technology as the panacea to education's problems.

The many educational areas that may benefit from computerized instruction have yet to be scientifically studied. Nevertheless, few will dispute that educational technology offers schools many new

possibilities, still fewer will contend that some degree of knowledge about computers is unnecessary for today's students, and almost no one will slough off the computer as merely the latest in a long line of educational toys.

Current Uses and Needs

A 1980 survey indicated that more than 90 percent of the nation's school districts made some use of computers. As of 1982, about one-third of all schools had at least one microcomputer or a terminal connected to a larger computer. This number has grown rapidly, increasing by 100 percent each year during the last decade.

However, despite the extraordinary rush to get the electronic classroom "plugged in," there are still far too few computers in schools to put the new technology to maximum use. In the U.S. and Canada, the current ratio of students to computers is 125 to 1. With this limited availability of computers, students are spending an average of less than 20 minutes a week at the computer keyboard. Secondary students attending computer-equipped schools spend less than one hour a week working with microcomputers. And this figure is somewhat inflated by the number of students taking career preparation courses in computer science who have extended periods of time on computers.

Obviously, students' access to computers must increase dramatically if education is to reap the greatest gains from high technology.

Furthermore, the distribution of computers in school systems currently is weighted in favor of the wealthier, suburban districts. A 1981 market survey revealed that microcomputers were present in more than 30 percent of the schools with the smallest number of low income students; only 12 percent of the schools with substantial numbers of poor students had microcomputers. This issue of equity is compounded by the fact that ownership of home computers is more prevalent among more affluent families.

Thus, students from wealthier backgrounds are not only likely to have greater access to computers in their schools, but in their homes as well. Many educators fear that this inequity in the exposure and access of low income youth to computers will further widen the existing gap in achievement levels between poor and wealthier students.

Needed: A Definition of Computer Literacy

While matters of computer access and equity are major issues facing education, they are by no means the only Information Age problems. The question of what and how much students should learn

SECONDARY SCHOOL MICRO-USERS DURING AVERAGE WEEK

ACTIVITY	MEDIAN No. OF MINUTES OF USE PER WEEK	PERCENT OF USERS WITH USE OF	
		1-16 MIN. PER WEEK	MORE THAN 1 HOUR
PROGRAMMING & COMPUTER LITERACY	55	18	44
DRILLS, REMEDIAL	17	48	9
LEARNING GAMES	11	56	9
WORD PROCESSING, et al.	30	28	31

THE JOHNS HOPKINS UNIVERSITY

about computers remains unanswered in many school systems. Although there is nearly universal agreement that all students should have some knowledge about computers, the concept of "computer literacy" is nebulous, with widely varying definitions.

In the past, computer literacy tended to refer to an awareness level of computer knowledge. Students would read about computers and learn about their capabilities, limitations, and applications. They would be taught about how computers were affecting the world and examine the historical development of technology.

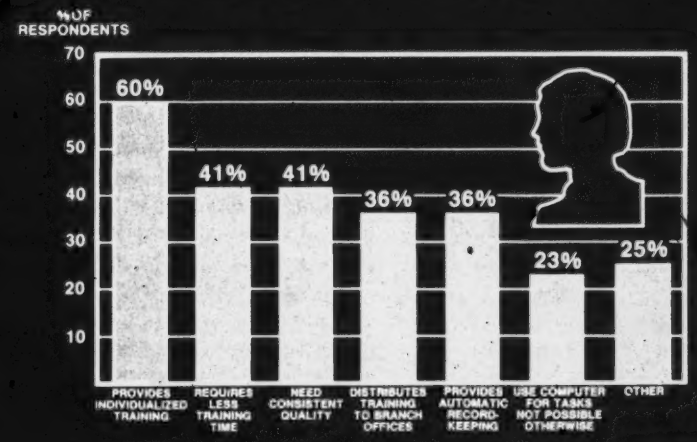
However, as educators are coming to realize that computers are even more important than originally suspected and that computers can be a very useful aid for students at all educational levels, a broader definition of computer literacy is emerging. Currently, the meaning of computer literacy includes a working knowledge of computers. That is, to become computer literate, students must learn — through some "hands-on" experiences — the rudiments of operating computers.

An even more sophisticated definition of computer literacy requires students to develop a useful level of programming skills. Although there is a growing recognition that this level of competency is needed, learning programming skills takes a substantial amount of instruction and practice. College freshmen find that at least a half-year course in programming is necessary to develop a basic level of competence.

Currently, the nation's secondary schools have neither the computer facilities nor the trained staff necessary to carry out this more comprehensive approach to computer literacy. However, this more

inclusive definition is a closer reflection of the level of computer skills which all students need as a basic part of their secondary school education.

WHAT FACTORS INFLUENCE TRAINERS IN DECISIONS TO USE COMPUTER BASED TRAINING?



TALMIS

Beyond the ongoing discussion about what comprises "computer literacy," secondary schools also require a more "in tune with the times" outlook on course offerings in computer science.

Novices to the computer world tend to equate computer programming with computer science. However, programming is only a part of the scope of computer science. According to one computer education expert, a secondary school computer science course should include a substantial amount of computer programming, but it should also cover such topics as problem solving, data structures, information retrieval, modeling and simulation, computer graphics, and business data processing. Such a course should have a liberal arts orientation rather than be categorized as a career preparation or mathematics course.

Furthermore, the overwhelming influence of computers in modern life and the emergence of the computer as an instructional aid indicates that both elementary and secondary schools must ensure that their students are computer literate and also that the com-

puter is examined for its usefulness throughout the school curriculum.

The computer may be used successfully in all school disciplines. Students can learn how to use computers to help solve social studies problems or to improve their writing. Science and mathematics, of course, can make use of the computer as a learning tool, but so can art and music classes. In the long run, all teachers must know how computers are used in their own subject matter disciplines so they may integrate this knowledge into their teaching.

The computer is rapidly becoming seen as a vital part of education in all courses and at all grade levels. For school systems to take full advantage of high technology, a thorough review of existing curricula will be necessary. Educators will have to examine how to infuse the appropriate use of computers throughout the range of students' studies.

Teaching About, With, and Through Computers

In addition to the continuing debate over what comprises "computer literacy," school systems with some experience in educational computers are now grappling with issues of how best to use the equipment for instruction.

As noted earlier, the narrowest definition of computer literacy involves instruction "about" computers. Schools now are also discovering the advantages of teaching "with" computers.

The most common type of teaching with computers is for drill and practice activities. Indeed, to many educators, computer-assisted instruction is synonymous with using the computer to drill students, examine student responses, and give immediate feedback. Most research on computers in education has centered around this type of computer use and most products marketed for education are for drill and practice in basic skill areas of math, reading, and language arts.

Computer assistance in these basic skills is proving very valuable because it frees teachers from spending an inordinate amount of time monitoring and directing these practice activities. Thus, teachers may devote more attention to the other areas of instruction where the "human touch" is essential.

However, the optimal use of computers for drill and practice work requires students to have maximum access to the computers. Students must have significant amounts of time to work "one-to-one" with the machines. Unfortunately, most schools do not yet have an adequate number of microcomputers to provide this amount of exposure to students. Additionally, using computers only for drill

and practice can be quite costly since most such programs can serve only a single student at a time.

Schools should carefully plan how they can most effectively use a small number of computers. Equally needed is some research examining various ratios of students-to-computers to determine at what point too few computers result in no appreciable gains in student achievement.

An extension of the drill and practice applications for computers — another form of teaching with computers — is "instructional student-computer dialog" in which the computer presents facts and ideas to students, evaluates student responses, and directs students to remedial explanations. These programs are gaining in use among schools because they broaden the uses of computers from merely testing students' work to actually teaching new concepts.

A relatively infrequent use of classroom computers today, but one which may hold the greatest potential for student learning, are simulations and model-building programs. Such uses are examples of not only teaching with technology, but also teaching through the computers.

In other words, these computer programs prompt a greater degree of student-initiated thought and decision-making and problem-solving skills; the computer acts not merely as the dispenser of information, but as the tool that students may manipulate to test out their own thoughts and inquiries. While these applications require more student programming abilities, they make use of the computers' abilities to create situations for study that otherwise would not be available to students.

Additionally, this use of computers can serve much larger numbers of students because it does not require one-to-one interaction with the machine as do most other educational computer programs.

Gaining High Tech Acceptance

Clearly, technology in the classroom is not merely a fleeting fancy. The potential for improving teaching and learning is immense. Furthermore, the nation's developing reliance on high technology demands that today's students have a thorough grounding in this staple of their future lives.

As educators recognize these facts, their acceptance of computers and technological tools in schools increases. Already many school districts have embarked on substantial computer literacy programs and improvement efforts. But recognition of the pressing need for

schools to integrate high technology into the instructional process is only the first step.

After the commitment is made to pursue altering and refining schools so they best assist students in meeting the demands of the information age, the difficult work begins. As discussed in later sections of this publication, a school or school system's decision to undertake this course of action must be followed by similarly strong commitments in essential areas such as:

- professional development
- planning and program development
- curriculum development
- financing and resource development.

High Touch: The People Side of Technology

"The teacher in the electronic school is indispensable; teachers become more, not less, important as technology increases."

—Shirley McCune

"The successful training of educators is what will turn all paraphernalia into an educational advantage."

—EPCOT principal

"Large, successful enterprises view people, not things, as their most valued resource — a good lesson for education."

—EPCOT principal

THE EARLY DAYS OF ELECTRONIC LEARNING were clouded with educators' hesitation, due primarily to concern that the microcomputer might be promoted as a replacement for teachers. However, as familiarity with high technology has increased and as many teachers have recognized the computerized classroom as an ally, not an enemy, the original fears about computers have been supplanted with hopes for their widespread use in education.

In fact, recent reports about computer-aided instruction emphasize the increasing, rather than diminishing, role that people must play if the most is to be made of educational technology. The "high touch" side of the Information Age is as vital as the "high tech" equipment itself.

The basic need for human contact is illustrated historically with the invention of television. Predictions abounded that television in America's homes would signal the death of the theater and movies. After all, television was more convenient, offered viewers choices, and was very inexpensive. However, the aspect which television

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This chapter is based on the remarks of Shirley McCune and David Moursund.

could not provide is the sense of community — the shared experience — which people derived from attending plays, concerts, and movies.

High technology — even the most advanced interactive equipment — cannot replicate this all-important human component. Computer manufacturers, well aware of the need to personalize and humanize their electronic "miracles" have dubbed their machines with unthreatening, familiar pet names such as "Lisa," "The Peanut," "Adam," and "Macintosh."

Additionally, one reason for the recent strides to make computers more user-friendly is not only to market the machines as easy to use but also to project an image of "humanness."

High touch, however, refers to much more than just the interaction between person and machine. More accurately, high touch is a recognition that an increased reliance on technology requires a simultaneous increase in uniquely human attributes and activities to maximize the usefulness of the electronics. This is proving to be especially true in education.

Not only do computers in the classroom free teachers to work and interact more personally and individually with students, the technology appears to create a need for the teacher to assume a greater counseling role with their students. While many computer programs provide students with feedback on their success and progress via the terminal, teachers must provide the overall direction and guidance regarding students' learning.

Additionally, computer-using teachers have the responsibility of helping students translate and integrate the knowledge gained from computer work to all other aspects of their intellectual and social development.

Professional Development

Another component of the high touch relationship to technology is the recognition that people determine the success or failure of any equipment — electronic or not. Consequently, the most important aspect of computers in education is the individual teacher. The most sophisticated hardware and advanced software will be useless unless the teacher supports and understands the use of such technology.

Thus, teacher training, as well as professional development for all educators, often is regarded as the key to making technology a viable educational tool. Some school systems, to their eventual regret, have invested all their technology dollars in the acquisition of electronic "things," leaving little or no resources for training the

staff who are charged with bringing the computer-assisted programs to life.

However, as time goes on, these school districts have awakened to the essential recognition that once the equipment purchases are made, the more difficult, time-consuming task of preparing teachers and administrators in the use of educational technology is the highest priority.

Although great variance exists among the nation's schools in bringing their staffs to an awareness, acceptance, and understanding of technology's implications for education, a general sequence of events and actions seems to occur in most school systems as they initiate plans for computer-assisted instruction.

A November 1983 article for *The Computing Teacher* described this sequence of development as composed of four stages. The author Sheila Cory writes:

"Full implementation of computer technology in a school system is a much more complex change than the implementation of a new method for teaching reading or even the restructuring of schools from open-space to self-contained. As such, the protocol for change relating to computers is necessarily different from the change model recommended for most changes in education.

"As a matter of fact, the idea of having a full plan in advance might very well be a Catch-22. It is impossible for a school system to know what to do with computers until its own faculty and staff know what computers can do, and it is not possible for them to know what the potential really is until they've purchased enough hardware, used enough software, and spent enough time learning to really understand what the possibilities are."

The four general stages of staff development for computer instruction are:

Stage 1: Staff development is not considered to be important at this point. If there is any staff development, it comes from the computer store where the hardware was purchased. It typically consists of a two-hour introduction by a computer store employee to a faculty, teaching them to turn the computer on and off and explaining how the programming tutorial will teach them everything they need to know about how to manage the computer and how to program.

Stage 2: The primary effort for staff development at this stage comes from individual teachers rather than from the system. Some teachers look for places to learn how to program so they can write their own programs for their students and modify and fix programs

that are given to them. Courses are taken at universities, through extension divisions, through computer stores, and from private companies offering instruction. The school system begins to realize the need for some staff development, and hires consultants that are recommended. The consultants are given little direction, except to "teach teachers what they need to know to use the computers" in a four-hour session. The staff development is sporadic through this stage, and involves no overall plan.

Stage 3: A giant step forward is made at this stage when someone is designated as the key person in charge of microcomputing for the school system. Frequently that person is responsible for staff development, and a variety of courses become available to all teachers in the system without their having to search them out or pay for them. Courses are offered in BASIC, Logo, software evaluation, use of specific software packages, etc. Participation in these courses is on a voluntary basis, and frequently the response to course offerings is overwhelming, with more teachers signing up than the instructor can accommodate.

Stage 4: At this stage, staff development is required for all people in the system who work with computers. In the same way that schools require all teachers who teach biology to be qualified to teach biology, at this stage there is the same expectation of teachers working with computers. The required staff development is differentiated for different groups of teachers, depending on the role the teacher plays in the computer utilization plan. Staff development is tied to the ongoing system plans and primarily offered in-house by a person employed full-time by the school system. Staff development is recognized as a critical component of successful utilization of computer technology.

Of course, these general phases of professional development are accompanied by progressive stages in other areas related to the full implementation of computer instruction, such as software and hardware acquisition, the development of computer literacy and computer-assisted learning programs, and overall attitudes to the use of computers. The following chart depicts the basic flow of these components:

Four Stages of Development for Full Implementation of Computers for Instruction

STAGE	HARDWARE	SOFTWARE	STAFF DEVELOPMENT	COMPUTER-ASSISTED LEARNING	COMPUTER LITERACY	ATTITUDE
Stage I Stage of Getting on the Bandwagon	Acquisition of hardware is primary focus Emphasis on quantity vs. quality Variety of hardware within one school system Joysticks or paddles purchased	Very little software acquired Available software is teacher-written or public domain	Staff development is considered unimportant Staff development is almost nonexistent	Undifferentiated from computer literacy Use of arcade games Any and all software is used at all grade levels	Undifferentiated from computer-assisted learning Sometimes course taught with one computer and 30 students	Ambivalence-fear, mistrust, uncertainty, curiosity Computers are for games and fun Computers are transient in education
Stage II Stage of Confusion	Acquisition of hardware still primary focus Apples purchased to run MECC software Language cards added to Apples	Acquired software is inexpensive or free Frequently software has bugs	Some teachers take courses from a variety of places Consultants give one-shot courses to interested faculty	Somewhat differentiated from computer literacy Some teachers attempt to match software to curriculum	Somewhat differentiated from computer-assisted learning Courses taught at initiative of individual teacher	Some teachers excited and enthusiastic Some teachers nervous Teachers feel everyone will need to program

STAGE	HARDWARE	SOFTWARE	STAFF DEVELOPMENT	COMPUTER-ASSISTED LEARNING	COMPUTER LITERACY	ATTITUDE
		Software often purchased by individual teacher MECC software purchased by system	No overall plan for staff development exists	Generally no planning for use of software	Courses typically targeted to one segment of student population Focus is on selection of "the best language"	
Stage III Stage of Pulling It All Together	Acquisition of hardware not the primary focus Purchases coordinated across the school system Purchase of peripherals takes place	Greater acquisition of professionally developed software Wide variety of software is purchased	A person is designated to coordinate effort Variety of courses offered through school system Participation in courses is voluntary	Totally differentiated from computer literacy Committees formed to evaluate software and recommend how to use it Software used for drill and practice, simulation, educational games, and tutorials	Totally differentiated from computer-assisted learning Committee established to define computer literacy Consideration of computer literacy for all students Greater machine use in courses	Some teachers see computers as panacea for education Some teachers very resistant Many teachers gaining interest and losing fear Teachers recognize they don't need to be expert programmers

STAGE	HARDWARE	SOFTWARE	STAFF DEVELOPMENT	COMPUTER-ASSISTED LEARNING	COMPUTER LITERACY	ATTITUDE
Stage IV Stage of Full Implementation	Continued acquisition of hardware Computers purchased for specific location and application Purchases characterized by simplest, least expensive machine to do a given task	Purchase of software is based on plans Libraries of software exist, both at system and school level	Differentiated for different groups of teachers Tied to the system plans Offered in-house by person employed by school system Participation in courses is required	Use of software based on research findings and ongoing evaluation Primarily used with aspects of curriculum not normally served by traditional instruction Recognition that computer-assisted learning is better for some children than for others	Computer literacy is clearly defined Taught throughout all grades in sequenced fashion Taught in various classes	Prevalent attitude of respect for capabilities and limitations of the computer Understanding of computer's role in education Appreciation of computer as a tool of great value to all

High Tech Schools: An Action Agenda

The First Steps — Awareness and Planning

"If our schools don't start looking ahead, they — and we — will be left behind."

"Unfortunately, the daily events cause principals to spend most of their time dealing with the present and looking back to the past."

"To be effective in the future, educators will have to stop using the assumptions of the past as a measure of what is right."

—EPCOT principals

Given The Changes In Society And The Need For modification and change of education and training systems, the inevitable question of where to begin must be raised. The potential and opportunities for change and restructuring are greater in a time of widespread economic and social change. Education's options will diminish as other changes begin to stabilize. This is especially true for those working at the local level where the primary responsibility and opportunity for change remains.

RECOMMENDATION: School systems need a long-range (3-5 years) model for initiating improvements.

Although plans must be developed for institutional change, it is important to remember that change results when individuals gain an understanding of what can be done and they identify or enlist others with the same concerns. The basis for action begins with an image or vision of what is needed.

Having a vision of where we are going provides a starting point or beginning point for change. This needs to be integrated with a number of activities that can result in change.

This chapter is based on the remarks and writings of Shirley McCune, David Moursund, and the principals' small discussion group work.

STRATEGIC PLANNING

Strategic planning is a technique for involving governance, school personnel, community groups, and students in a process of reviewing future-oriented data and developing a strategic vision for the future development of their schools. The strategic plan provides a framework for program and program delivery planning and for the evaluation of programs toward the strategic vision.

Strategic planning must be integrated with program and program delivery planning. A summary of the relationships among these levels of planning is:

Type of Planning	Primary Responsibility	Questions To Be Answered	Outcomes
Strategic Planning	Board and superintendent	Are we headed in the *right* directions?	Statement of mission and strategic goals that provide a framework for decision making
Program Planning	Central office and principals	Are we doing the *right* things to achieve our goals?	Goals and objectives for district and building programs
Program Delivery Planning	Principals, teachers, and counselors	Are we doing things *right?*	Delivery plans, evaluation of individual classrooms, and identified areas for staff development

Strategic planning, like other types of planning, is not an event but an ongoing process. A series of stages which may be identified include the following:

1. *Preparing a Climate for Planning and Change*

This first phase of strategic planning emphasizes the sharing of information about external forces influencing schools, helping people understand the process, and collecting data needed for the development of the plan.

2. *Developing a Strategic Plan*
This phase of planning emphasizes the involvement of district governance and staff in a series of planning sessions to identify a strategic plan for the district based on the opportunities and threats found within the local environment. This requires the involvement of top decision makers but it should include the input of staff members, community, and students. A preliminary plan developed by governance is reviewed by as many groups as possible and modifications are made which can improve the vision or goals.

3. *Developing Program Plans*
Once a strategic vision has been developed to provide direction or answers to the question "Where are we going?" it is essential that staff are involved in answering the question, "How do we get there?" The planning process places primary reliance on central office and building level staff members.

4. *Implementation of the Plan*
The implementation of the plan is the implementation of program and program delivery plans. This usually requires training, management procedures, and methods of assessing progress toward the goals.

5. *Monitoring Progress and Reassessing the Strategic Plan*
A strategic plan should result in the development of a series of critical decisions which need to be made. These decisions provide a framework for decision making, resource allocation, and evaluation of progress. This monitoring of the plan includes continued scanning of changes in the larger environment.

RECOMMENDATION: School personnel need a means of keeping up to date on societal, political, and technological trends that may affect education.

One of the steps in strategic planning is environmental scanning— scanning the forces external to schools and evidence about the current status of schools. Schools currently have very little information of this kind which can be used for management decision making. Additionally, student information data bases are needed; these would include information on various characteristics of students, the different achievement of groups of students,

longitudinal patterns of achievement, the costs of various programs, etc.

Thus, schools are in great need of management information systems. Microcomputers could make such data available for the central office staff, building staff, and classroom teachers.

RECOMMENDATION: School systems need to increase their efforts to inform the staff, the media, and all segments of the community about: school successes; the social transformations having an impact on education; and the schools' needs and strategies to adapt to the Information Age.

Parent involvement and volunteer programs are valuable ways of developing support for the improvement of schools. Parent involvement may be enhanced through the use of "contracts," newsletters, parenting programs, parent-student activities, etc. Volunteer programs that involve parents, community members, and local businesses in services to students, teachers, principals, or other administrators are also an important means of extending support for schools.

Public information programs are often viewed as mere "extras" by school administrators. However, the ability of schools to communicate with the general public is a critical way to secure not only financial support, but also a strong degree of public confidence in the schools' abilities to meet the educational needs of the society. These communications tasks require a systematic and continuous plan for informing, updating, and seeking input from a wide variety of audiences.

The Role of the Principal

Perhaps one of the most important observations about change in an information society is the increased importance and power of the individual to facilitate change. In the areas of planning and awareness, the principal can:

- Launch a personal development campaign to learn more about the trends and requirements of the information society by reading books that point to a new vision of society (*Megatrends, In Search of Excellence, The Change-Makers,* etc.) and by enrolling in courses or workshops on management processes, changing patterns of leadership, strategic planning, administrative applications of computers, etc.

- Survey students, parents, business, and community groups to find out their perceptions of schools and their visions for schools in the future.
- Form a parent/community advisory group to work with staff members in identifying needs, recommending programs, and monitoring progress toward school goals.
- Develop a plan for the procurement and use of microcomputers for school management, instructional management, computer literacy, and computer-assisted instruction.
- Develop a building level staff forum to present ideas and information on trends and external data that may have an impact on schools and brainstorm ways the school can meet the challenges.

Examining the Curriculum

"School curricula are notorious for lagging behind the times."

"The longstanding argument about whether to stress skills or knowledge, liberal arts versus science is a waste — obviously, students need all these abilities."

"Computer literacy and computer-assisted instruction are distinctly different propositions; learning about computers is the basis of the former and using computers to learn is the latter."

—EPCOT principals

Research on the outcomes of education support the importance of quality curriculum and instruction. Furthermore, efforts to improve the curriculum can result in tangible changes in a relatively short period of time.

RECOMMENDATION: Schools need to reassess all aspects of the curriculum based on the educational needs of the future.

Some of the changes which might result from tying an inspection of curriculum to the nation's emerging trends:

- an increase in the requirements for foreign language study
- more coursework on the global society and the cultures of various nations
- a revamping of career education so that courses of study are linked to the realities of the future market place

- an increased emphasis on all forms of communications skills — reading, writing, listening, and interpretation
- development of course components that emphasize the development of higher order thinking skills such as problem solving, decision making, analytical reasoning, and synthesis.
- the inclusion of courses in keyboard skills, beginning at the elementary level.

RECOMMENDATION: All students must become computer literate. They should gain a substantial level of computer awareness and develop a functional level of skill in using computers as an aid to problem solving in a variety of disciplines.

To achieve this goal, school systems must determine an appropriate definition of computer literacy, formulate and adopt a formal policy on computer literacy, and embark on a rigorous program of professional development for principals, other administrators, and teachers.

At a minimum, computer literacy must translate into student knowledge about the functions of computers and how they are affecting the society as well as student skill in actually operating computers for a range of practical applications. Computer literacy should be considered as separate and distinct from computer-assisted instruction.

RECOMMENDATION: All aspects of the curriculum should be reassessed in light of the existence and growing potential of computer-assisted instruction.

All school subject areas and grade levels may be able to benefit from the use of computer-assisted instruction. Each area of the curriculum should be reviewed with the intention of discovering where and how computer-assisted instruction may reap gains in student achievement. However, such instruction should occur only when it is an educationally and economically sound aid to the instructional program.

The various forms of computer-assisted instruction should also be examined. Are schools only using computers for drill and practice activities? Could other applications such as model-building and simulations add yet another positive dimension to instruction?

RECOMMENDATION: Schools should initiate a plan for curriculum mapping.

The ongoing review of the scope and sequence of the curriculum is an essential component of quality education programs. Frequently, this function is not performed or performed only by central office staff. As a result students are often subjected to a "shotgun" curriculum, remediation needs are not identified, and the challenges of progressive levels of difficulty are never realized.

Curriculum mapping is a technique for charting out the core scope and sequence of content and skills to be delivered to students. This core ensures a level of quality control but does not limit the creativity of the individual teacher. Successful curriculum mapping efforts require the ongoing involvement of teachers and the development of communications among teachers. Thus, a curriculum mapping process must involve specialized content expertise, skills in curriculum development, and procedures for ongoing communications.

RECOMMENDATION: Given the barrage of computer hardware and software for educational uses, schools must establish means of evaluating and selecting equipment that best meets the particular needs of the schools.

The selection of appropriate educational technology is often one of the most difficult aspects of implementing computer-assisted instruction programs. Educators must have assistance within their school district in determining what equipment will best serve the particular school or program.

Software selection is an especially confusing task, particularly if the educators charged with making the purchases are novices to educational technology. However, schools — as the software consumers — are in the position to and should require that software manufacturers and vendors produce evidence of their products' success and applicability. Educators must ask: Where and how has this software been tested and what data do you have regarding the outcomes of using this software in educational settings?

RECOMMENDATION: Schools must strengthen their recognition of students' academic achievement, particularly in areas such as math, science, and career preparation.

Traditional funding sources, as well as parent/teacher groups, booster clubs, etc., should be encouraged to make money and give funds to "mathletes" and "chemletes" as well as athletes. Students should be awarded letters in math, physics, chemistry, and vocationally-related cocurricular activities, similar to athletic letters.

The Role of the Principal

As the "program manager" of the school's curriculum, the principal should consider taking the following actions:

- In conjunction with staff members, review the existing curriculum in terms of its success in meeting the needs — particularly the future needs — of the school's students. Brainstorm with the faculty ways in which the curriculum might be amended or altered to address the realities of a high tech world.
- Assess how computers currently are being used in the school. Is their use limited or perhaps too narrowly defined? Again, with faculty, determine which areas may be enhanced by computer-assisted instruction.
- Assist the school district as a whole in establishing a software/hardware clearinghouse. Such a center might also serve as the hub for professional development activities related to educational technology.
- Place a premium on academic achievement by instituting recognition and incentive projects for outstanding scholarship.

Professional Development for All

"With or without technology, a school will never be any better than the quality of its classroom teachers."

"Principals need much more than just a passing knowledge of technology if they are to translate the future into today's schoolrooms."

—EPCOT principals

RECOMMENDATION: School systems must analyze how the Information Age is altering the functions of various job categories, particularly principalships, and accordingly, offer intensive professional development opportunities.

Changes in the roles of administrative and management staff inevitably require strategies for development and training. This is particularly important for principals. Most administrator education programs have been based on a view of the principal as a "mini-superintendent." Effective schools research focuses on the role of the principal as an instructional leader, but the job also requires substantial talents in the areas of staff development, resource management, and community outreach. Far too frequently, principals are not afforded adequate training for successfully serving in these capacities.

RECOMMENDATION: With the advent of the electronic classroom, school systems must make a strong and continuing investment in the training and retraining of teachers in the use of emerging technological aids to education.

Teacher education has frequently been isolated from research findings and state of the art developments. Most attention has been focused on a theoretical understanding of education rather than on the skills of the teaching/learning process. Inservice training often is sporadic and unfocused.

Teacher development and training requires four basic components:

1. Involvement of teachers in the communication systems of districts and buildings.
2. Design and implementation of ongoing generic and skills-based training programs which provide tangible ways of improving curriculum and instruction.
3. Opportunities for gaining feedback or coaching as to how they may improve their skills.
4. Information on the outcomes of instruction and reinforcement for positive results.

Some of the skills that should be included in any teacher training program are:

- Interpersonal skills which can identify and overcome patterns of differential expectation and treatment
- Content development skills for identifying objectives, a reasonable sequence for learning, and methods of monitoring and remediating learning achievement
- Varied instructional styles to meet individual and cultural differences in learning styles

- A thorough grounding in how to use technological advances to the best advantage in the instructional process
- High touch skills of counseling, integrating, and directing students who are working with computer-assisted instruction
- Student reinforcement techniques to increase individualized motivation and incentives
- Curriculum management techniques to assess individual and group progress, identify remediation needs, and monitor the pace of the learning process.

The Role of the Principal

Actions which principals may take in the area of professional development for administrators as well as faculty members include:

- Promote the need for increased training for school administrators in areas such as environmental scanning, the application of technology to instruction, problem analysis, community outreach, strategic planning, and resource development and management.
- After consulting staff members to develop an agenda of professional development needs, design and implement sequential staff training programs including areas such as curriculum mapping, interpersonal skills, coaching/supervision skills, computer applications, instructional methodologies, etc.
- Identify ways to support and reward high levels of staff performance by personal comments, letters or notes for personnel files, special assignments, or flexible assignments.
- Regularly present and discuss issues to faculty apart from day to day school operations. Examine the external forces acting on education and solicit suggestions on how the individual school should respond.

Forging Partnerships To Improve Schools

"Oh, the things that business could teach education — and vice versa."

"Schools need to take a hard look at what they do best and offer that in exchange for some expertise which educators lack."

"Educators have to allow themselves to learn from other sectors of the society."

—EPCOT principals

The increasing interdependency of society's institutions, the rapid changes brought on by the Information Age, and the recognition that pooling resources may result in gains for all contributors are convincing educators that forming partnerships with business, higher education, and the community at large is essential for schools' future success.

RECOMMENDATION: Schools must actively recruit "partners" from business and industry to jointly and creatively solve problems of basic education and career training.

In seeking partners, education will have to disabuse itself of traditional notions about the relationships between the public and private sectors. Building partnerships does not mean seeking philanthropy. Education too often has called upon business for handouts. True partnerships are based on the assumption that both parties will reap some rewards. For schools, the private sector can offer resources, expertise, job market analyses, assistance in program development, tutors, on-site experience, etc. In return, education will provide business and industry with better-trained employees, and consequently, decreased retraining expenses, a lower turnover rate, and reduced hiring and recruitment costs.

RECOMMENDATION: Schools also must engage in collaborative activities with institutions of higher education to forge a strong continuum of educational services.

All levels of education will face the transformations of the Information Age. Pre-college education and higher education must coordinate their responses to those changes. For instance, schools must articulate what the training needs of teachers are and will be. Likewise, colleges and universities can serve schools as advisers on matters such as expectations for college students, curriculum, student assessment, and the translation of research into practice.

The Role of the Principal

Principals can exercise a great deal of creative leadership by looking outside the immediate school community for allies. Some suggested actions:

- Form a business/industry/education council to identify areas for collaboration and encourage the development of programs.
- Identify business/industry resources in the community, establish contacts and relationships with such resources, and develop programs for involving business/industry in improving schools.
- Examine ways to increase the educational options for students through summer enrichment programs, honors programs, summer camps, Saturday open media centers, open computer centers, meaningful placements in business/industry, interdistrict programs, cable-computer interactive classes, etc.
- Contact local universities and colleges to develop school/college joint programs or to explore exchanges of resources (i.e. — colleges may use the school population for research in return for a college faculty member conducting an inservice workshop).

FINANCING THE FUTURE

"School budgets are no longer an aid to wise management; they are a justification for inhibiting all actions."

"High tech costs *are* high, but remember: the costs of not educating students are astronomical."

—EPCOT principals

The costs for implementing the goals for instructional use of calculators and computers will depend on how rapidly they are implemented, the depth to which they are to be achieved, and current availability of relevant resources.

1. Teacher training is essential. But most school districts already spend a significant amount of money in this area.
2. Software and courseware need to be acquired or developed. But most school districts already spend money for curriculum development and for books and other support materials.
3. Calculator and computer hardware must be made available at an increased level. This is apt to require increased expenditures.

RECOMMENDATION: School systems and schools must examine existing resources and redirect those resources to meet the requirements of high tech education.

There will be two distinct types of costs: "out of pocket" expenses and the cost of existing resources which will be redirected.

Out of pocket costs can be kept to a minimum. The cost of existing resources which can be redirected can bear most of the initial costs in working toward the computer education goals.

A school district has substantial discretionary resources in terms of time and energies of its personnel, materials and supplies money, and so on. For example, a curriculum specialist can work on computer aspects of the curriculum or on other topics. An inservice day or professional meeting can focus on computers or on other topics. Libraries and resource centers can choose to buy computer or calculator books, journals, and other computer-related materials. Many school systems have a computer facility and staff oriented toward administrative computing. Some of this staff and/or part of the facility might be devoted to instructional applications.

RECOMMENDATION: Expenses for high technology needs must be built into school budgets, not regarded as "one-shot" shopping sprees.

Currently computers are an "add-on" expense. They are not being used to replace existing personnel, nor do they lessen the need for supplies or other equipment currently being used. Indeed, computers require maintenance and repair. They use supplies such as paper, magnetic tapes, and magnetic disks.

Consider the effect of increasing a current school budget by 1 percent and dedicating this increased funding exclusively to the acquisition of computer hardware. The typical school system now spends in excess of $3,000 per student per year. In other words, only an extra $30 per student per year would be needed for hardware.

The Role of the Principal

At both the district and building level, principals may help solve the problems of financing educational technology. Some suggestions:

- Communicate the needs *and* costs of school improvements to the school community and nurture the citizens' and parents' active voice in the budget-making process.
- Contact corporations, service clubs, and interested individuals for donations or loans of equipment.
- Allocate a fixed percentage (1 or 2 percent) of the school's funds for planned progress in acquiring equipment and training staff members.
- Submit evidence of educational technology's success with students in addition to any requests for additional funds.

A Final Word

Living in an information society requires new styles of leadership, new styles of participation, and an ongoing concern about teamwork and involvement. Attention to activities such as these is a necessary part of change. Positive change is likely to result in schools when educators:

- provide a vision of the direction for future change and an ongoing rationale of the need for change;
- develop a data base and understanding of needed changes;
- involve a variety of individuals and groups in identifying problems and solutions which can lead to the desired outcomes;
- provide staff with knowledge and skills necessary for the implementation of changes;
- procure the financial, physical, and human resources necessary for change; and
- establish a monitoring system for identifying and reinforcing progress.

These activities must be undertaken with an understanding that developing new and expanded visions of the role of education and training in an information society is a responsibility that all educators share. And likewise, all educators hold the mandate to ensure that the visions become realities.

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